to the eighteenth day after section, the organ can be excited to discharge, but the shocks are weaker than normal. After the nineteenth day, however, no response is obtained to stimulation either of the nerve or of the electrical organ itself. Thus the irritability of the organ disappears with that of the nerve, whereas a muscle is excitable long after the degeneration of its motor nerve with end-plates is complete. It may be mentioned that the organ-current, or current of rest, and the irreciprocal conductivity diminish during the period of lowered irritability of the organ, and are absolutely abolished after the nineteenth day, thus pointing to the excitatory nature of both these sets of phenomena.

The experiments on the action of curare are less satisfactory, owing to the enormous doses (1 grm. for a fish of 1200 grms.) which are necessary to paralyse the indirect excitability of the electrical organs. Since in these large doses the curare excites central discharges, it is necessary to cut all the electrical nerves to prevent paralysis by fatigue. In this case, however, with a sufficient dose of curare, direct and indirect excitability are abolished simultaneously. The same interdependence of direct and indirect excitability is observed in paralysis by fatigue, in marked contrast to the behaviour of voluntary muscle, where a muscle on direct stimulation gives a practically normal contraction after complete fatigue by stimulation of its nerve.

Veratrin, which causes a marked prolongation of the excitatory change in skeletal muscle, was found by Garten to produce a somewhat similar effect on the electrical discharge of the torpedo. This drug, however, diminishes and very rapidly abolishes the direct and indirect excitability of the electrical organ, and no proof is afforded that the prolonged response may not be due to the state of artificial "fatigue" produced by the drug, or that it is in any way specific. Waller's experiments have shown that veratrin has practically no action on the nerve, and although Garten quotes certain of his own experiments which appear to indicate an action of this drug on non-medullated nerve, the strength of the solution employed must be regarded as too great for the demonstration of the specific action of the drug.

We cannot, therefore, regard the experiments with veratrin as detracting in any way from the support afforded to the nerve-ending theory of excitation by the results of nerve-section. It is remarkable that a change which, as the current of action in nerve, needs all the appliances of a well-fitted laboratory for its demonstration, should, by a mere subdivision of the fibrils and their enclosure in compartments separated by non-excitable partitions, be able to produce the strong shocks of high intensity which characterise the discharge of the whole organ. No better demonstration could be afforded of the futility of those hypotheses which would explain the passage of the nerve-impulse as a mere propagated polarisation, and would deny any energy-producing changes in the axis-cylinder itself. The absence of fatigue in medullated nerve does not imply absence of chemical change, but merely equivalence of disintegration and reintegration, an equivalence probably connected, as Waller has suggested, with the presence of a medullary sheath. E. H. S.

FLUORINE.

Le Fluor et ses Composés. Par M. Henri Moissan. Pp. xii + 396. (Paris: G. Steinheil, 1900).

THERE could scarcely be a greater contrast than that between the gaseous substances most recently added to our list of elements; fluorine on the one hand, argon and its companions on the other. The existence of the hypothetical element fluorine was postulated in many well-investigated compounds as early as the beginning of the present century; yet, on account of its intense chemical activity, fluorine was not prepared as a free element until 1886, despite the numberless attempts which had been made to isolate it in the intervening period. Argon, on the other hand, owing to its absolute inertness, and to the fact of its occurrence along with the very inert nitrogen, led an unsuspected existence until 1894, although it was contained in enormous quantities in the atmosphere—a constant subject of investigation. The compounds of fluorine, then, were known long before the element itself,—compounds of argon are still wanting. Indeed, as has been pointed out (Sedgwick, "Argon and Newton," p. 2), the name element in the ordinary sense cannot properly be applied to argon and its companions at all, since that term implies the existence, or at least the possibility of existence, of compounds concerning which we are still in total ignorance. As yet there is no chemistry of argon.

The time, however, has now arrived when fluorine and its compounds can be brought under review so as to give a picture of the element in itself and in its combinations, which in main outlines, at least, may be looked upon as final. Prof. Moissan was obviously the man to execute this task; he has fortunately undertaken it, and the book before us gives the result of his labours. As evidence of the extent of the author's research, we may adduce the bibliography given as appendix, which occupies eighty-five pages, and contains references to about six hundred books and papers. These references are arranged alphabetically according to authors, and also chronologically, beginning with Agricola, 1558, and ending with the year 1899.

In the book itself the author's investigations have naturally the first place, and one of the chief points of interest is that M. Moissan not only gives us an account of his apparatus, experiments and results, but also of the leading thoughts which guided him from one experiment to another, until the culmination was reached in the liberation of the gaseous element. The student beginning research could not find a more stimulating record of failure and eventual success than that afforded in Chapter i., on the isolation of fluorine. Chapter ii. deals with the most recent apparatus for the production of fluorine by electrolysis. At a temperature of about $-80°$, attained by the evaporation of a mixture of solid carbonic acid and acetone, it is possible to use an electrolytic vessel of copper instead of platinum, provided that the hydrofluoric acid employed is free from water. This substitution brings elementary fluorine within the scope of any well-equipped chemical laboratory. Chapter iii. deals with the physical properties of fluorine, its liquefaction, and the action of the liquid on various substances. In

Chapter iv. we have a systematic account of the action of fluorine on the non-metallic elements and on some of their compounds, together with a somewhat detailed study of the non-metallic fluorides. The action of fluorine on the metals and their compounds forms the subject-matter of Chapter v., the organic fluorine compounds receiving treatment in Chapter vi. The last chapter in the book deals with the atomic weight of fluorine, the volumetric composition of hydrofluoric acid, the action of fluorine and hydrofluoric acid on glass, and the position of fluorine in the system of the elements. The author definitely places fluorine at the head of the halogen family, sufficient stress, however, being laid on the points in which fluorine resembles the elements of the oxygen family; such as the ease with which it unites with carbon, and the analogies exhibited by hydrofluoric acid to some dibasic acids. A short summary of the properties of fluorine concludes the volume, and for frontispiece there is an excellent portrait of the author.

The book is as interesting as a monograph can well be, and M. Moissan has earned the gratitude of all chemists by thus placing before them a connected record of one branch of his splendid activity. J. W.

OUR BOOK SHELF.

A Text-Book of Physical Chemistry. By Dr. R. A. Lehfeldt. Pp. xii+308. (London: Edward Arnold, 1899.)

A FEW years ago the teacher of physical chemistry seeking a suitable elementary text-book, dealing with the more recent developments of the subject, which he could put into the hands of a class of students approaching the study of physical chemistry for the first time, was somewhat embarrassed to find one. This state of things is now changed for the better by the recent appearance of several very excellent works; among these Dr. Lehfeldt's book will take a high place. The author explains in his preface that the book "is intended to contain what a student—with limited time and many subjects to learn—may usefully read. It is by no means written to suit any examination, but still is written with the practical requirements of students in view."

Dr. Lehfeldt has succeeded in avoiding the unessential and in explaining the fundamental ideas of modern physical chemistry in a thoroughly lucid manner, so that a student who has grasped the contents of this book will experience little difficulty in appreciating the meaning of the larger handbooks or original memoirs.

An introductory chapter on physical units will be useful to chemical students, who are, perhaps, apt to be slipshod in such matters. This is followed by a chapter on molecular weights in gases and solutions, which includes electrolytes and the ionic theory, and by a very well-considered chapter on the connection between physical properties and chemical constitution. The principles of thermodynamics are then explained; and the two laws (*a*) of chemical equilibrium in a system of perfect gases at constant temperature, and (*b*) of the influence of temperature on chemical equilibrium are deduced from them. This chapter presupposes some knowledge of the elements of the calculus, but any student who wishes to understand physical chemistry must make up his mind to acquire the small amount of mathematical knowledge requisite.

The applications of the two thermodynamic theorems to chemical change and equilibrium in homogeneous and heterogeneous systems are then taken up. This treatment has the great advantage that the whole of the phenomena can be grouped in a very simple way, the close relationship of chemical and physical change is clearly brought out, and the student is not bewildered by the apparent multiplicity of the phenomena. The book concludes with a brief but most interesting chapter on the theory of the galvanic cell, and the connection between electromotive force and chemical affinity. The book may be unhesitatingly recommended as one of the best of its kind.

The only misprint we have noticed occurs on p. 141, line 18, where "increases" is written in place of "decreases." T. E.

An Introduction to Analytical Chemistry. By G. G. Henderson, D.Sc., M.A., and M. A. Parker, B.Sc. Pp. 228. (London: Blackie and Son, Ltd., 1899.)

THIS is a compact work covering the ground of ordinary qualitative analysis as well as the tests for a number of organic substances, and also containing an account of the most important processes of quantitative analysis.

Without being designed on any new plan or being explanatory to the fullest extent, the book is written in a scientific spirit. The authors state that they have made free use of the works of Dittmar and others, and it is perhaps not uncomplimentary to remark that the influence of that sterling chemist is apparent in the book.

The directions for work are clear and practical, and the analytical methods quite satisfactory. Perhaps the least useful part of the book is that dealing with organic substances and their separation from mixtures. This branch of analytical art is very difficult, and the particular form of it, which has been encouraged by certain examining bodies, has brought disaster to many a good student. It is difficult to understand what useful purpose is served by the efforts of second-year students to prepare for recognising the constituents of, say, a mixture of urea and an inorganic salt. It is of no importance to medical men, it does not help the teaching of organic chemistry, and it crowds out practical work which would be of real value. The examination of such mixtures is a matter for an analyst of mature knowledge and experience. A. S.

Maryland Weather Service. Vol. i. Pp. 566. (Baltimore: The Johns Hopkins Press, 1899.)

THE Maryland State Weather Service was established in 1892, and its reports and climatic charts are favourably known to meteorologists. In 1896 a plan of closer co-operation between the National and State Weather Bureaux was proposed by Prof. W. L. Moore and adopted. This marked the commencement of a new and very important period in the history of the Service, and the present volume is the first published since the two organisations have been in close connection. The energies of the Service are now to be devoted chiefly to the publication of special reports on the climatology of the State, and if the volume before us is to be taken as an earnest of future ones, we may be pardoned a feeling of envy at the sumptuous way in which scientific work of this kind is presented to the public in America. We notice that it is proposed to publish in the near future a full account of the climatic features of Maryland, in which the physiography, meteorology, hydrography, medical climatology, agricultural soils, forestry, crop conditions and the fauna and flora of the State will be considered.

The present volume is confined to the physiography and meteorology, and includes an introduction by Prof.